

# PATENT SPECIFICATION

NO DRAWINGS

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## Improvements in or relating to Printed Circuits.

### COMPLETE SPECIFICATION

We, BLAUPUNKT-WERKE GESELLSCHAFT MIT BESCHRAENKTER HAFTUNG, a German company, of 200, Hildesheimer Waldstrasse, Hildesheim, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention concerns the manufacture of printed circuits of the type consisting of a base on which separate parts and connecting leads are provided.

There are a number of different methods for manufacturing so-called printed circuits.

15 The methods which have hitherto been used in the art are based on the common idea of first manufacturing, by an appropriate method, metallically-connected and electrically-conducting connecting paths between the points of a circuit. After circuit components have been mounted in holes on the base plate, soldering or dip soldering, which merely fulfils the purpose of attaching these parts to the conducting connections already applied to the base, is effected.

The principal methods hitherto employed for making printed circuits are:

1. The vapour deposition of conducting lines in a high vacuum on an insulating base 30 with subsequent galvanic reinforcement.

2. The etching out of the conducting paths on insulating material pasted over with copper foil.

3. The application of previously stamped-out metal conducting paths.

4. The powder method, in which a not quite fully set hard paper, evenly coated with powdered silver, is pressed with a heated stamp having the form of the conductor pattern, thus producing at the places heated under pressure an adhering conducting and solderable silver path.

5. The various chemical and physical methods of making insulating material conductive either over the entire surface or only

a circuit outline for subsequent copper plating by galvanic methods.

All these methods require a large number of operations and are therefore expensive. Special presses are necessary for the pressing 50 and powder methods referred to in 3 and 4. The etching method involves expensive consumption of material.

The method proposed in accordance with the invention is distinguished from these by 55 extremely simple operations and is therefore particularly suitable for mass production.

According to the present invention there is provided a method of making a printed circuit which comprises applying metal 60 particles to an insulating base plate so that they adhere thereto in a substantially electrically-discontinuous circuit conductor outline, positioning components appropriately on said base plate and thereafter simultaneously 65 forming electrically-continuous conductors in conformity with said outline and securing the components to the conductors by dip soldering.

The simplest method proposed by the 70 invention is as follows:

#### Example I.

The desired circuit outline is first applied in a suitable form, using a liquid synthetic resin on a hard paper board intended to form 75 a printed circuit base plate. The resin may be applied by a brush through a stencil or sprayed on through a stencil, printed on, applied by offset or sieve printing methods, or in any other manner. A metal powder—which may be slightly silver-plated or tin-plated to prevent oxidation—is dusted on this adhesive coating of liquid synthetic resin. This metal powder remains adhering only to the sticky synthetic resin layer, and after the excess is shaken off, an image remains of the appropriate circuit in the form of an electrically-discontinuous powdery coating. The parts produced in this manner such as lead connections, condenser electrodes, coils, 85

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which are formed as spirals, are then brought to the temperature necessary for setting the synthetic resin layer, the individual grains of the powder layer thus receiving their necessary firmness of attachment. It is completely unnecessary that the dusted-on metal powder should already itself have an electric conductivity over the initially formed circuit outline after the setting of the synthetic resin pattern. Desired components are then appropriately positioned on the circuit panel produced in this manner and the panel is now immersed in a liquid solder bath whereby the metal powder firmly connected by the synthetic resin layer is given a continuous solder coating by dip soldering, this solder coating providing the electric continuity of the conducting path.

The solder coating adheres firmly to the outside of the metal powder layer which acts as an adhesion layer and in this case does not need to have any electric conductivity. The solder coating adheres more firmly, for example, to the base than is the case with the method of etching out the conducting paths on insulating material pasted with copper foil.

Simultaneously the circuit components such as resistances, condensers and the like with their connecting wires through holes provided in the base plate are connected into the circuit. The method of the invention therefore has the advantage that only one operation of dip soldering is necessary to provide a solder coating on the metal powder firmly connected with the synthetic resin layer and to connect the attached components.

In the soldering, each individual particle of the metal powder coating is simultaneously connected with its neighbour with the formation of a smooth coherent solder coating. This tin layer which is applied by dip soldering then represents the current paths firmly adhering to the base of insulating material for the printed circuit, and the connecting wires of the attached components are, at the same time, firmly connected to the paths by dip tinning.

A considerable saving in costs is achieved relative to prior art, since no special machinery is required for manufacture, nor any costly consumption of metal involved as with the etching process, for example. All the conditions of mass production are given, since the individual steps are the simplest possible.

*Example 2.*

Metal powder is strewn on a hard paper plate provided with a dried thin coating of

synthetic resin. The plate is then passed between two rollers for example, of which the upper carries a reproduction of the conducting network and is heated. As the plate passes through the rollers, the synthetic resin coating is softened only in areas corresponding to the desired circuit outline. The metal powder which has been strewn on adheres to these places and unites with the synthetic resin layer. The rest of the metal powder is removed, the synthetic resin is hardened and the plate which has been treated in this manner, after positioning desired circuit components thereon, is dipped into a solder bath in order to apply an electrically-continuous coherent solder coating over the circuit outline and to secure the components in position.

WHAT WE CLAIM IS:

1. A method of making a printed circuit which comprises applying metal particles to an insulating base plate so that they adhere thereto in a substantially electrically-discontinuous circuit conductor outline, positioning components appropriately on said base plate and thereafter simultaneously forming electrically-continuous conductors in conformity with said outline and securing the components to the conductors by dip soldering.

2. A method as claimed in Claim 1 wherein the base plate is of hard paper.

3. A method as claimed in claim 1 or 2 wherein the electrically-discontinuous circuit outline is formed by applying a liquid synthetic resin to the base plate in conformity with the desired outline, dusting metal powder onto the resin, and thereafter hardening the resin.

4. A method as claimed in claim 1 or 2 wherein the electrically-discontinuous circuit outline is formed by strewing metal powder onto a base plate provided with a dried thin coating of synthetic resin, passing the plate between rollers one of which is heated and carries a reproduction of the desired circuit outline so that the powdered synthetic resin coating is engaged by the heated roller, and hardening the synthetic resin coating.

5. A method of making a printed circuit substantially as hereinbefore described in Example 1 or Example 2.

6. A printed circuit made by the method of any one of the preceding claims.

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